Using Coaching and Personal Feedback to Improve the Generic Engineering Competences of Students

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The implementation of a new course in analog integrated circuit design at the Technical University of Denmark is presented. The course is designed using constructive alignment and addresses many of the practical aspects of doing integrated circuit design. The intended learning objective, teaching activities and the assessment are presented and it is demonstrated how coaching and personal feedback – often used in the industry – is used to improve the generic engineering competences of the students in alignment with CDIO.

Based on the teacher's 16 years of industrial experience the course is designed to emulate a project in a company, thereby creating an educational environment with a huge focus on the generic engineering competences of the students. In the project/course, the teacher acts as the manager of the company and the students as employees/project members. It is discussed how project status meetings and a review meeting support the teaching of both technical and generic skills. In both types of meetings the teacher mainly acts as a secretary taking notes but also as a facilitator for the discussion and knowledge sharing taking place during the meetings.

As the students are to construct a circuit block, the students spent most of the time designing and analyzing circuitry using computer aided design. It is described how the teacher again acts as a facilitator helping the students to improve their problem solving skills. This is done by presenting the students to the problem solving methodology shown in Fig. 1. The methodology is a simplified version of a methodology used by the US Army [1]. The focus in the teaching is to constantly coach the students to solve their problems inherently meaning that the students take ownership of their design task as well as their learning.

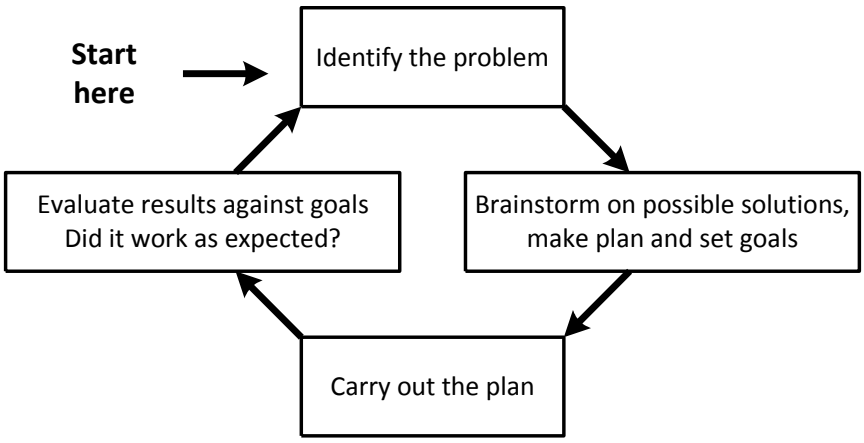

Figure 1. Problem solving methodology.

Another essential element in teaching the course, helping to improve other generic engineering competences of the students, is a methodology for providing personal feedback on their behavior [2], [3]. The paper describes how the 4-step model (Describe – Express – Consequence – Suggest), shown in Fig.2, is used to provide feedback to the student on how their behavior is perceived, explain potential consequences of these and finally suggests a changed or continued behavior depending on the feedback being developing or positive.

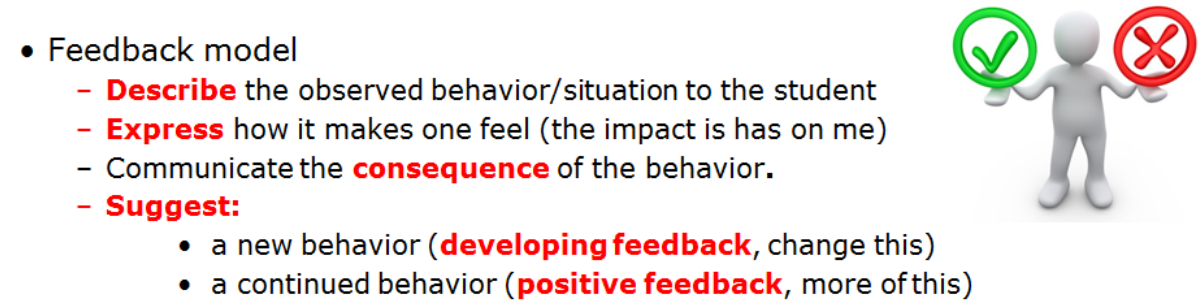

Figure 2: Feedback model

It is an essential pre-requisite for the improving the generic engineering competences of the students that a working environment is created in the course where the students feel safe to actively participating. This also means that it is mandatory that the students acknowledge that intermediate failure is a natural part of engineering development. This topic is specifically addressed in both this course and the pre-requisite course.

The result of the evaluation using the Course Evaluation Questionnaire (CEQ) is shown in Tab. 1. The overall score was 4.3 out of 5 clearly shown that the students appreciate the course. The questionnaire evaluates the course in 5 categories and the results are discussed in detail in the paper. Using coaching to guide the students could lead to unclear goals but the score in the category "Clear goal and standards" of 4.2 clearly shows that this was not the case. The score in the category "Generic competences" of 4.2 also shows that the goal of the course to improve these was fulfilled. Many comments in the questionnaire stated that it was a stimulating and exiting course which is also supported by the score of 4.8 in the category "Motivation".

Table 1. Result of CEQ

Category	***Average (1 -5)***
Good teaching (GT)	4.4
Clear Goals and Standards (CG)	4.1
Appropriate Workload (AW)	3.8
Generic Skills (GS)	4.2
Motivation (M)	4.8
Overall	**4.3**

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